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Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

Comments - NBP Public Notice #2 | GN Docket Nos. 09-47, 09-51, and 09-137

Via the ECFS

COMMENTS OF IEEE 802.18

IEEE 802.18, the Radio Regulatory Technical Advisory Group ("the RR-TAG") within IEEE 802[2] hereby submits its Comments in the above-captioned Proceeding. This document was prepared and approved by the RR-TAG, and was reviewed by the IEEE 802 Executive Committee.[3]

The members of the RR-TAG that participate in the IEEE 802 standards process are interested parties in this proceeding. We appreciate the opportunity to provide these comments to the commission.

INTRODUCTION

1. On September 4, 2009, the Commission released a public notice seeking comment on the implementation of Smart Grid technology in support of the Commission's efforts to complete a National Broadband Plan.
2. In these comments, the RR-TAG addresses some of the issues that the Commission raises in the public notice.
3. In our response, we are responding to selected questions in the NOI, and, for clarity, we repeat the Commission's questions.
4. We note that many of the questions raised in this NOI are a repeat of questions already posed within the NIST Smart Grid Interoperabilty Standards Project. Answers to these

[1] The IEEE Local and Metropolitan Area Networks Standards Committee ("IEEE 802" or the "LMSC").

[2] This document represents the views of IEEE 802.18. It does not necessarily represent the views of the IEEE as a whole or the IEEE Standards Association as a whole.

questions derived from the NIST project work are expected to be complete by mid-2010. Given the complexity of the issues, the RR-TAG does not believe that it is possible to comprehensively respond to the FCC questions by October 2 and therefore our responses are less detailed then we would prefer. It is our understanding that the NIST Project serves as the central coordination point for technical expertise for questions raised in this NOI.

IEEE 802.18 RESPONSES TO THE COMMISSION'S QUESTIONS

5. **Question 1:** *Suitability of Communications Technologies. Smart Grid applications are being deployed using a variety of public and private communications networks. We seek to better understand which communications networks and technologies are suitable for various Smart Grid applications.*
6. **Question 1a:** *What are the specific network requirements for each application in the grid (e.g., latency, bandwidth, reliability, coverage, others)? If these differ by application, how do they differ? We welcome detailed Smart Grid network requirement analyses.*
7. Specific communications requirements for any given Smart Grid applications will drive the selection of communications technologies. Beside network reliability and coverage, bandwidth, jitter and latency are the most critical issues when developing the technical requirements for the Smart Grid network communications. For example, the communications network needs to provide real-time low latency capabilities for applications such as Centralized Remedial Action Schemes (CRAS), Transmission and Substation SCADA, Phasor Measurement, and Large Load Control Signaling. These requirements drive the need for high-speed fiber optic, and/or microwave communications to support those capabilities. On the other hand, applications such as automatic meter reading and data beyond SCADA, which are more latency-tolerant, could utilize communications technologies such as broadband wireless, satellite, unlicensed wireless mesh, and licensed wireless. Applications supporting the Transmission & Distribution Crew of the Future present a different class of requirements challenges such as reliability without power, coverage and mobility. Coverage of the communications networks is also of concern for large utilities whose service territories cover tens of thousands of square miles of cities, mountains and desert. Power system equipments located in remote regions are not usually able to take advantage of public wireless networks and require the installation of private wireless or wired networks with independent power capability. Reliability is also of paramount concern for critical monitoring and control of the power system. Past experience

has shown that, unless special measures have been taken, communications networks will not be available during emergency conditions – conditions where monitoring and control of critical electrical infrastructure is most needed. This is why most utilities do not rely on public wired or wireless communications network for their critical operations.

8. **Question 1b:** *Which communications technologies and networks meet these requirements? Which are best suited for Smart Grid applications? If this varies by application, why does it vary and in what way? What are the relative costs and performance benefits of different communications technologies for different applications?*
9. Table 1 below lists some of the Smart Grid applications and the associated communications technologies which may be employed for each application. The specific technology selected for each particular application varies based on factors such as bandwidth, latency, and reliability.

	Network Requirements			
Applications	**Bandwidth**	**Latency**	**Reliability**	**Commonly Used Communications Technologies**
Transmission and Substation SCADA	M	Cycles to Seconds	H	Fiber optic, microwave, copper lines, satellite
Large System Load Control	L	Seconds to Minutes	H	Microwave, broadband wireless
Remedial Action Scheme	L	Cycles	H	Fiber optic, microwave
Centralized Remedial Action Scheme	H	Cycles	H	Fiber optic, microwave
Phasor Measurements	H	Cycles	H	Fiber optic, microwave, broadband wireless
Data Beyond SCADA	M	Minutes to Hours	M	Microwave, broadband wireless, satellite
Distribution Automation (routine monitoring)	L	Minutes	M	Microwave, satellite, unlicensed wireless mesh
Distribution Automation (critical monitoring and control)	L	Seconds	H	Microwave, satellite, unlicensed wireless mesh
Distributed Generation monitoring	L	Seconds	H	Microwave, satellite
Distributed Generation control	L	Seconds		Microwave, satellite
Protective Relaying	L	Cycles	H	Fiber optic, microwave, high-speed wireless
Advanced Metering (meter reading, disconnect, communication to HAN)	M	Seconds to Minutes	M	Unlicensed wireless, broadband wireless,

Outage Detection	L	Minutes	H	Fiber optic, microwave, broadband wireless, unlicensed wireless mesh
T&D Crew of the Future	M	L	H	Broadband wireless ,
Load Control Signaling	L	Minutes	H	Fiber optic, microwave, licensed wireless
Dynamic Pricing	L	Minutes	M	Broadband wireless, unlicensed wireless
Home Energy Management	L	Minutes	M	Broadband wireless, unlicensed wireless

Legends:
L - Low
M - Medium
H - High

Table 1 – Communications Network Requirements by Application

10. **Question 1c:** *What types of network technologies are most commonly used in Smart Grid applications? We welcome detailed analysis of the costs, relative performance and benefits of alternative network technologies currently employed by existing Smart Grid deployments, including both "last mile," backhaul, and control network technologies.*
11. A wide variety of network technologies will be used in Smart Grid applications. Table 1 lists candidate technologies by application. For high performance needs, fiber optic cables and microwave links could be used. For moderate performance, commercial wireless broadband wireless, geosynchronous satellite, and licensed radio spectrum could be used. For short range needs such as home area network unlicensed wireless technologies can be used. The developing Smart Grid will likely use a combination of these technologies with the appropriate match made between needs and available communications network capabilities and costs. To these ends, Smart Grid communications systems should be developed in a manner such that the higher levels of the software stack are independent of considerations of the implementation of Layers 1 and 2 to the greatest extent possible.
12. **Question 1d**: *Are current commercial communications networks adequate for deploying Smart Grid applications? If not, what are specific examples of the ways in which current networks are inadequate? How could current networks be improved to make them adequate, and at what cost? If this adequacy varies by application, why does it vary and in what way?*
13. No Comment

14. **Question 1e:** *How reliable are commercial wireless networks for carrying Smart Grid data (both in last-mile and backhaul applications)? Are commercial wireless networks suitable for critical electricity equipment control communications? How reliably can commercial wireless networks transmit Smart Grid data during and after emergency events? What could be done to make commercial wireless networks more reliable for Smart Grid applications during such events? We welcome detailed comparisons of the reliability of commercial wireless networks and other types of networks for Smart Grid data transport.*
15. For Smart Grid to be fully functional in emergency situations there may very well be rerouting of communications required that goes beyond the normal reconfiguration capability of the nominal network. Access to a database that details the power source capabilities of each communication system element may well be a critical item in determining priorities when scheduling the repair of system elements in a disaster situation.
16. **Question 2:** *Availability of Communications Networks. Electric utilities offer near universal service, including in many geographies where no existing suitable communications networks currently exist (for last-mile, aggregation point data backhaul, and utility control systems). We seek to better understand the availability of existing communications networks, and how this availability may impact Smart Grid deployments.*
17. **Question 2a:** *What percentage of electric substations, other key control infrastructure, and potential Smart Grid communications nodes have no access to suitable communications networks? What constitutes suitable communications networks for different types of control infrastructure? We welcome detailed analyses of substation and control infrastructure connectivity, potential connectivity gaps, and the cost-benefit of different alternatives to close potential gaps.*
18. Useful information regarding substation communications capabilities will be provided by the NTIA which is conducting a broadband mapping of substations.- http://www.ntia.doc.gov/press/2009/BTOP_mappingtotals_090909.html
19. Based on the above application scenarios and utility experience, many utilities will use fiber optic communications for most or all electric facilities operating at or above 66kV. Microwave communication may be installed in rural areas, where cable construction may be limited due to permits or cost. This way, all legacy services (protective relaying, SCADA, and voice) and advanced Smart Grid services are supported.
20. New substations required for load growth are constructed with fiber optic communications, which supports legacy services and prepares the site for future advanced Smart Grid

services. Additionally, equipment upgrades at 230kV substations (relay upgrades) have driven the need for communication network enhancements to meet redundancy requirements for protection. These enhancements have contributed to the increase in grid reliability from diverse communication links.

21. Within service territories, network connectivity gaps exist in very rural areas where 115kV substations are much farther apart and are distant from customers. Fiber optic and microwave installation in these areas are either impractical or cost prohibitive. For this reason, utilities will likely using wireless broadband and satellite technologies to close the gaps in these areas.
22. **Question 2b:** *What percentage of homes have no access to suitable communications networks for Smart Grid applications (either for last-mile, or aggregation point connectivity)?*
23. No comment. IEEE 802 has no information regarding percentage of homes covered by communications networks.
24. **Question 2c:** *In areas where suitable communications networks exist, are there other impediments preventing the use of these networks for Smart Grid communications?*
25. No comment.
26. **Question 2d**: *How does the availability of a suitable broadband network (wireless, wireline or other) impact the cost of deploying Smart Grid applications in a particular geographical area? In areas with no existing networks, is this a major barrier to Smart Grid deployment? We welcome detailed economic analyses showing how the presence (or lack) of existing communications networks impacts Smart Grid deployment costs.*
27. The key criterion here is “suitable”. While in some cases there may be coverage, it may or may not meet all of the application requirements, such as latency (i.e. phasor monitoring), security and/or reliability (i.e. two-week battery back-up for LMR). In areas with no existing suitable network, the barrier to Smart Grid deployment is the higher cost which must be justified and recovered in rate cases. The magnitude of that impact varies based on individual utility territory characteristics and regulatory environment.
28. **Question 3: Spectrum.** *Currently, Smart Grid systems are deployed using a variety of communications technologies, including public and private wireless networks, using licensed and unlicensed spectrum. We seek to better understand how wireless spectrum is or could be used for Smart Grid applications.*

29. **Question 3a:** *How widely used is licensed spectrum for Smart Grid applications (utility-owned, leased, or vendor-operated)? For which applications is this spectrum used? We welcome detailed analyses of current licensed spectrum use in Smart Grid applications, including frequencies and channels.*
30. Currently US utility companies use proprietary networks and licensed spectrum in frequency bands such as – 450,700, and 935 MHz.
31. **Question 3b:** *How widely used is unlicensed spectrum? For which applications is this spectrum used? We welcome detailed analyses of current unlicensed spectrum use in Smart Grid applications, including frequencies and channels.*
32. Presently, the IEEE 802 standards are applied primarily in the following US unlicensed or nonexclusively licensed frequency bands – 900 MHz, 2.4 GHz, 3650-3700 MHzand 5 GHz. 60 GHz is under development.
33. **Question 3c**: *Have wireless Smart Grid applications using unlicensed spectrum encountered interference problems? If so, what are the nature, frequency, and potential impact of these problems, and how have they been resolved?*
34. Utilities have successfully used unlicensed spectrum for AMR applications; Smart Grid applications are the emerging follow-on step. Utilities will have the opportunity to deploy efficient, affordable new wireless technology in unlicensed spectral bands. These technologies will support a wide range of Smart Grid applications including AMI, LMR, Field Area Network, as well as backhaul and secondary paths for some applications which require redundancy for wired communications. New technologies continue to improve interference mitigation techniques. The key to successful wireless deployment will be appropriate system design. Some of the design issues are being developed today in IEEE 802.
35. Unlicensed bands are a good choice for current and future deployments of some Smart Grid applications. A wide range of increasing application demands can be enabled through additional dedicated use spectrum and more efficient use of the unlicensed bands. While more spectrum is one way to address increased application demands, higher spectral efficiency, such as through adopting newer, more efficient and reliable digital techniques, can also meet these requirements without consuming increased spectral resources. This can be seen in the increasing efficiency and intelligence of ISM band technologies, which make increasingly better use of scarce spectrum. Some examples include Wi-Fi (based on IEEE 802.11), Bluetooth (based on IEEE 802.15.1) and ZigBee (based on IEEE 802.15.4).

36. Reliability does not come exclusively from the type of spectrum used, but from the system design.
37. We all agree that spectrum and wireless infrastructure used to support the availability of basic necessities like water, gas and electricity must be available at a reasonable cost. Increased spectral efficiency and new interference mitigation techniques, such as CSMA, LBT, random back-off, and their support in many standards, as well as standards mandating good coexistence, further support the use of unlicensed spectrum. IEEE 802, for example, has a dedicated group (IEEE 802.19) whose primary task is to encourage good coexistence between the new standards as they are developed and those previously completed.
38. **Question 3d:** *What techniques have been successfully used to overcome interference problems, particularly in unlicensed bands?*
39. With so many successful, broadly deployed technologies using unlicensed spectrum, interference has been a topic of much interest and study. Although applications come and go (cordless phones left 900 MHz, then left 2.4 GHz) over time, new mitigation techniques (CSMA, LBT, random back-off, adaptive frequency hopping, etc.) and increased spectral efficiency via more advanced modulation techniques allow ever more applications, users and throughput to fit in a given spectral band. Radio interference problems can further be reduced by smart software and efficient coding algorithms. Most systems use a combination of these techniques appropriate to their application environment.
40. The Part 15 rules were created to enable many users to share large blocks of unlicensed spectrum. If the FCC were to allocate new spectrum for use in Smart Grids it should carefully consider the types of applications it is proposing to enable and the related spectrum access and sharing rules
41. It is worth noting that all of the IEEE 802 wireless networking standards are designed to provide equal and fair access to the spectrum allowing large numbers of users to efficiently share use of the radio channels.
42. It is important to note that significant interference will cause a well-designed communication system's performance to degrade – most current systems withstand a great deal of interference before they fail.
43. RF devices can communicate in environments where interference is possible using a variety of techniques to mitigate the effect of interference.
44. Frequency diversity can be achieved instantly via spread spectrum techniques or over time by channel changing or channel hopping.

45. Media access control methods include Carrier Sense Multiple Access (CSMA), Listen Before Talk (LBT) and random back-off, or exponential fallback. Some IEEE 802 standards also specify centralized scheduling for medium access control.
46. Other error detection/correction methods, such as Forward Error Correction (FEC), attempt to reconstruct interfered transmissions at receive time.
47. In wireless communication, given enough interference beyond the threshold, all communications can be made to fail. Hence, we believe there is a need for dedicated use spectrum for some critical Smart Grid infrastructure applications.
48. **Question 3e:** *Are current spectrum bands currently used by power utilities enough to meet the needs of Smart Grid communications? We welcome detailed studies and discussion showing that the current spectrum is or is not sufficient.*
49. Both licensed and unlicensed RF spectrum has an important role to play in the Smart Grid. It is important that specific requirements supporting any given Smart Grid application drive the selection of communications technologies used to support that capability.
50. The history of new technology deployments shows that performance and bandwidth needs are underestimated in early stages. So, while current Smart Grid deployments and near-term deployment plans are tailored to available spectrum, it would be prudent to begin the process now of allocating more. While the timing is right to request an allocation of licensed spectrum, we believe more rigor and broader collaboration in making the case for this spectrum is required in order to be successful. Specifically, we are concerned with the position that licensed spectrum is required to enable secure, reliable and scalable smart grid deployments as we believe that security, reliability and scalability are not inherent in the use of licensed spectrum and must be engineered and managed as part of any solution.
51. Electric utilities need dedicated spectrum. They operate private internal communications systems because they need highly reliable networks in places commercial networks are not available. Worker and customer safety demands that utilities cannot afford dead spots or dropped calls when lives are at stake. Additionally, utility control systems require low latency levels that are just not available from commercial networks. Finally, utilities build their own control systems to survive disasters and remain up and running when all other communications systems are down. However, it is important to also consider that it is very costly and complicated to own spectrum.
52. **Question 3f**: *Is additional spectrum required for Smart Grid applications? If so, why are current wireless solutions inadequate?*

53. Yes dedicated use spectrum is highly desireable for the reasons stated above.
54. **Question 3fi:** *Coverage: What current and future nodes of the Smart Grid are not and will not be in the coverage area of commercial mobile operators or of existing utility-run private networks? We welcome detailed descriptions of the location, number and connectivity required of each node not expected to be in coverage.*
55. Outside of urban areas, the coverage of carrier networks is too inconsistent for grid network operations.
56. **Question 3fii:** *Throughput: What is the expected throughput required by different communications nodes of the Smart Grid, today and in the future, and why will/won't commercial mobile networks and/or private utility owned networks on existing spectrum be able to support such throughputs? We welcome detailed studies on the location and throughput requirements and characteristics of each communications node in the Smart Grid.*
57. Critical utility services should not have to compete with consumer use of the network, which can lead to congestion of the network, especially at critical times.
58. Question 3fiii: Latency: What are the maximum latency limits for communications to/from different nodes of the Smart Grid for different applications, why will/won't commercial mobile networks be able to support such requirements, and how could private utility networks address the same challenge differently?
59. Critical grid monitoring and control applications measure latency in milliseconds across hundreds or thousands of miles.
60. **Question 3fiv:** *Security: What are the major security challenges, and the relative merits and deficiencies of private utility networks versus alternative solutions provided by commercial network providers, such as VPNs? Do the security requirements and the relative merits of commercial versus private networks depend on the specific Smart Grid application? If so, how?*
61. The security of a native commercial public carrier network does not meet the NERC-CIP requirements for utility services. If commercial networks were to be used, it might be necessary to add security mechanism, such as VPN, to encrypt the session. However, two-factor authentication VPN might introduce additional latency.
62. **Question 3fv:** *Coordination: Are there benefits or technical requirements to coordinate potential allocation of spectrum to the Smart Grid communications with other countries? What are they?*

63. The electrical grids between the United States and Canada are interconnected; a fault on the grid in the US can cascade to Canada and back. The Canadian government has allocated 30 MHz of dedicated spectrum in the 1.8 GHz band for smart grid usage. The potential benefits of a coordinated spectrum allocation would include a more defined roadmap for Smart Grid wireless device design for the vendors and possible closer data sharing and collaboration between cross-border utilities for optimized operation of the North American power grid.
64. Broader coordination would allow more effective use of a scarce resource and promote economies of scale.
65. **Question 3fvi:** *Spectrum allocation: Are there any specific requirements associated with Smart Grid communications that require or rule out any specific band, duplexing scheme (e.g., FDD vs TDD), channel width, or any other requirements or constraints?*
66. IEEE 802 would welcome additional spectrum allocation for Smart Grid applications. Given the range of Smart Grid applications and application requirements, and given the different suitability of higher and lower frequencies for shorter range higher bandwidth or longer range applications, it is important that the allocation(s) be appropriate for the application. It is also important that transmit power limits be appropriate for the application.
67. **Question 3g:** *If spectrum were to be allocated for Smart Grid applications, how would this impact current, announced and planned Smart Grid deployments? How many solutions would use allocated spectrum vs. current solutions? Which Smart Grid applications would likely be most impacted?*
68. If spectrum were allocated, it would be worked into rolling deployment plans as timelines and budgets allowed. Depending on the spectrum allocated (bandwidth and frequency) and sharing rules, it would likely be used for more critical applications, such as LMR, and broadband applications for voice, video and backhaul components to vehicles and other assets. It is important to remain focused on application requirements to drive solutions. We should also keep in mind that we will probably not find one solution for all needs - it will probably take a range of communications technologies to meet the diverse application requirements. Further, the set of technologies will likely continue to evolve, with particular technologies improving in a new generation of the same base technology, or being replaced by a different technology.
69. If spectrum were to be allocated for Smart Grid applications, it will accelerate nationwide Smart Grid deployments. Dedicated spectrum will increase the communication performance and reliability of mission-critical data, such as distribution system SCADA,

real-time outage management, demand-management control, distribution station and security monitoring, mobile work dispatch and accomplishment reporting, emergency management vehicle communications, real-time energy monitors, automated two-way communicating home thermostats; and in-home two-way real-time energy monitors, outage management, theft detection, and remote disconnect.

70. **Question 4: Real-time Data.** *The Smart Grid promises to enable utility companies and their customers to reduce U.S. energy consumption using a variety of technologies and methods. Some of the most promising of these methods use demand response, in which utility companies can directly control loads within the home or business to better manage demand, or give price signals to encourage load shedding. Other methods reduce energy consumption simply by providing consumers access to their consumption information, via in-home displays, web portals, or other methods. Central to all of these techniques is energy consumption and pricing data.*
71. **Question 4a:** *In current Smart Meter deployments, what percentage of customers have access to real-time consumption and/or pricing data? How is this access provided?*
72. No comment.
73. **Question 4b:** *What are the methods by which consumers can access this data (e.g., via Smart Meter, via a utility website, via third-party websites, etc.)? What are the relative merits and risks of each method?*
74. No comment.
75. **Question 4c:** *How should third-party application developers and device makers use this data? How can strong privacy and security requirements be satisfied without stifling innovation?*
76. No comment.
77. **Question 4d:** *What uses of real-time consumption and pricing data have been shown most effective at reducing peak load and total consumption? We welcome detailed analyses of the relative merits and risks of these methods.*
78. No comment.
79. **Question 4e:** *Are there benefits to providing consumers more granular consumption data? We welcome studies that examine how consumer or business behavior varies with the type and frequency of energy consumption data.*
80. No comment.

81. **Question 4f:** *What are the implications of opening real-time consumption data to consumers and the energy management devices and applications they choose to connect?*
82. No comment.
83. **Question 5: Home Area Networks.** *We seek to understand the ways in which utilities, technology providers and consumers will connect appliances, thermostats, and energy displays to each other, to the electric meter, and to the Internet.*
84. **Question 5a:** *Which types of devices (e.g., appliances, thermostats, and energy displays, etc.) will be connected to Smart Meters? What types of networking technologies will be used? What type of data will be shared between Smart Meters and devices?*
85. A wide variety of devices including thermostats, lighting controls, energy displays, appliances, pool pumps, plug-in electric vehicles, distributed energy resources (e.g., premises-based solar photovoltaic or wind resources), premises energy storage units (e.g., battery appliances), and energy management systems (EMSes) may be connected to Smart Meters via a Home Area Network (HAN) interface in the meter.
86. In mature HANs (e.g., many intelligent HAN devices), Energy Service Providers (e.g., Utilities) will likely deploy or require Consumers to purchase an alternate HAN gateway device (e.g., standalone or integrated into a home broadband router or EMS). There are use cases for HANs that bridge the Smart Meter and other information providers (e.g., OpenSG HAN System Requirements Specification v1.04[4]). The key application for a Smart Meter-connected HAN is near real-time consumption information. All other HAN applications can be provided through non-Smart Meter HAN gateways, though as universal providers, Utilities will likely provide a default channel to these applications via the Smart Meter HAN.
87. Depending on the HAN Architecture discussed above, many potential hardware technologies may be suitable to enable HAN applications
88. Data types for the HAN are enabled at the application layer. Energy service providers have selected the Smart Energy profile to enable this functionality. Smart Energy profile is a National Institute of Standards and Technology-designated Smart Grid interoperability standard. It was designed to be platform-agnostic and supported by any hardware technology that is capable of Internet Protocol transmissions. Smart Energy profile supports secure communication of demand response (DR), time-of-use (TOU) and tier-based pricing,

[4] http://osgug.ucaiug.org/utilityami/Shared%20Documents/UtilityAMI%20HAN%20SRS%20-%20v1.04%20-%20080819-1.pdf

text messaging, and instantaneous consumption and production (e.g., premises-based distributed energy resources) data between Smart Meters and HAN devices.

89. **Question 5b:** *Which types of devices (e.g., appliances, thermostats, and energy displays, etc.) will be connected to the Internet? What types of networking technologies will be used? What type of data will be shared between these devices and the Internet?*

90. As discussed in the response to question 5(a), most HAN device applications enabled through a Smart Meter-connected HAN gateway could also be enabled via an Internet-connected HAN gateway. The exceptions are applications involving near real-time energy consumption information, as it is impractical and technically challenging to backhaul this data through the Utility AMI communication system and make it available to a device in the same premises via the Internet. Local HAN communication through the Smart Meter is much more practical and cost effective. Some HAN applications involving energy market transactions like capacity bidding and spinning reserves may require response times that are best provided via Internet-connected HAN gateways.

91. Internet-connected HAN networking technologies will likely use familiar Consumer networking technologies (e.g., 802.11 (Wi-Fi), 802.15.1 (Bluetooth), 802.3 (Ethernet), 802.16 (WiMAX), and powerline carrier) on the premises side of the Internet gateway. Many product manufacturers are designing network bridging devices that bridge Smart Meter HAN communications with Internet communications. These devices often have whole premises energy management capability as well (i.e., Premises Energy Management System) or are integrated into existing Consumer appliances (e.g., home broadband modem, Wi-Fi router, cable set-top box, security system console, PC-based devices).

92. **Question 5c:** *We welcome analyses that examine the role of broadband requirements for Home Area Networks that manage energy loads or deliver other energy management services.*

93. No comment.

CONCLUSION

94. IEEE 802.18 submits these responses to the Commission's questions in the Smart Grid NOI with the hope that our contributions will support the Commission's efforts in completing a National Broadband Plan. IEEE 802.18 looks forward to working with the Commission in future proceedings related to this issue.

Respectfully submitted,

/s/

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